

Historic, Archive Document

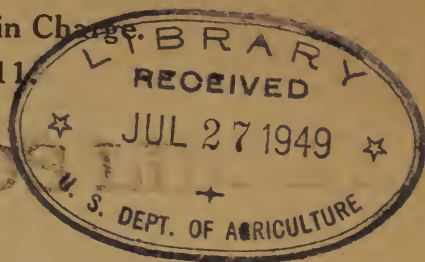
Do not assume content reflects current scientific knowledge, policies, or practices.

Ex 65
cop 4
PORTO RICO AGRICULTURAL EXPERIMENT STATION

D. W. May, Special Agent in Charge

Mayaguez, June, 1911

CIRCULAR No. 14.



A Study of Mosquitoes in San Juan, Porto Rico.

By

W. V. TOWER.

UNDER THE SUPERVISION OF
OFFICE OF EXPERIMENT STATIONS.
U. S. DEPARTMENT OF AGRICULTURE.

MAYAGUEZ, P. R.
MAYAGUEZ PRINTING COMPANY.

1912

PORTO RICO AGRICULTURAL EXPERIMENT STATION

D. W. May, Special Agent in Charge.

Mayaguez, June, 1911.

CIRCULAR No. 14.

A Study of Mosquitoes in San Juan, Porto Rico.

By

W. V. TOWER.

UNDER THE SUPERVISION OF
OFFICE OF EXPERIMENT STATIONS.
U. S. DEPARTMENT OF AGRICULTURE.

MAYAGUEZ, P. R.
MAYAGUEZ PRINTING COMPANY.
1912.

PORTO RICO AGRICULTURAL EXPERIMENT STATION.

(Under the supervision of A. C. TRUE. Director of the Office of
Experiment Stations, United States Department
of Agriculture.

WALTER H. EVANS,
Chief of Division of Insular Stations, Office of
Experiment Stations.

STATION STAFF.

D. W. MAY, Special Agent in Charge.
W. V. TOWER, Entomologist.
P. L. GILE, Chemist.
G. L. FAWCETT, Plant Pathologist.
C. F. KINMAN, Horticulturist.
E. G. RITZMAN, Animal Husbandman.
T. B. McCLELLAND, Assistant Horticulturist.
C. N. AGETON, Assistant Chemist.
W. E. HESS, Expert Gardener.
C. ALEMAR, Jr., Stenographer.

Withdrawn

8/12/48

CONTENTS.

	Page.
Introduction	5
Work done by the experiment station for the city of San Juan.....	10
Where mosquitoes breed in San Juan.....	16
Conclusions	18
Mosquito work taken up after the survey of 1911.....	21

A STUDY OF MOSQUITOES IN SAN JUAN, PORTO RICO.

By W. V. Tower.

INTRODUCTION.

Only a few years ago it was discovered that malaria and yellow fever are carried by the mosquito. The mosquito is an intermediate host of a parasite which develops in them and which is then transmitted to man. Man cannot be infected with malaria or yellow fever except through a mosquito bite, and the mosquito itself cannot become infected unless it obtains the blood from a person having malaria or yellow fever. The opinion years ago was that these diseases were caused by living in damp places and many believed that certain houses were full of these diseases and those who lived in them were sure to have the dreaded maladies. These houses were, no doubt, near the breeding places of anopheles, the malarial mosquito, or *Aedes* (*Stegomyia*) *calopus*, the yellow fever mosquito. The anopheles breeds generally in clear pools either of fresh rain water or pools which have been left by the going down of small brooks and streams, while *Aedes* (*Stegomyia*) *calopus*, the yellow fever mosquito, develops in water barrels, old tin cans and cisterns.

Although malaria exists on the island the writer has never found specimens of anopheles, the malaria mosquito. All collections of larvae have been made around the cities and very few in the country. This may account for not taking anopheles as it is a country species although it is sometimes found in cities, breeding in water barrels.

Very little work has been done in Porto Rico on the mosquito problem, although there is at times malaria; also yellow fever was reported previous to the American occupation.

During 1906 the writer collected the larvae of the following species around Mayagüez:

Species.	Where found.
1. <i>Aedes mediovittata</i> Coq.	Taken from water collected in hollow tree trunks, from tin cans and bamboo pots.
2. <i>Culex bisulcatus</i> Coq.	Larvae collected in an old pail half full of cement and water.
3. <i>Chironomus anonymus</i> Will.	Found in same container as No. 2.
4. <i>Aedes (Stegomyia) calopus</i> Meigen.	Larvae found in water tank connected with a letter press.
5. <i>Culex toweri</i> D & K.	Larvae found in bamboo pots placed in a cacao planting near the station.
6. <i>Culex quinquefasciatus</i> Say.	Found in tin cans, fountains, barrels, and any place where water stands. The common house mosquito of the Tropics.
7. <i>Culex similis</i> Theo.	

The above determinations were made by Frederick Knab of the National Museum at Washington, D. C. Note that among them is the much dreaded *Aedes (Stegomyia) calopus*, the yellow fever mosquito.

Yellow fever outbreaks occurred during the Spanish régime, but since the American occupation no cases have been reported. Dr. S. B. Grubbs, chief quarantine officer for Porto Rico, in a letter to the writer, under date of May 1, 1911, states: "I can say in general, however, that yellow fever existed in both San Juan and Ponce nearly all the time up to within one year of the Spanish war. There was more or less of it also in Mayagüez, Humacao and other garrisoned ports. About 1896 or 1897 there was quite an epidemic here in San Juan and I believe also throughout the island. At that time there were probably 1,000 cases in San Juan.

Since the American occupation there have been no cases occurring in Porto Rico. Several cases have been removed from vessels to the Quarantine Station, but the disease has gone no further."

This decrease may be explained by the strict quarantine regulations which are enforced at the ports of entry. Some of the neighboring islands have frequent outbreaks. The work of stamping out yellow fever in Havana and Panama has been very successful.

In Havana, Cuba, during the year 1900 to 1901, when the

sanitary authorities were putting forth every effort known at that time to sanitary science in order to control the march of the disease, the yellow fever cases numbered 1240 and the deaths 305. In the following year 1901-1902, when yellow fever was fought on the theory that the specific agent of this disease is transmitted solely by means of the bites of infected mosquitoes, there were 61 cases and 6 deaths. (a)

The yellow fever mosquitoes are here in great numbers and may be found breeding in the rain barrels and cisterns, but they do not carry the disease as there is none at the present time on the island. At certain seasons of the year the house mosquito is very plentiful over the island, in fact, in many localities they are so bad at times that they may be considered a pest. They are more numerous during the rainy season as all slight depressions in the soil, old cans, pots, bottles, cocoanut husks and many other receptacles are constantly being supplied with water and in them the female mosquito lays and the larvae develop. The large ponds and mangrove swamps around San Juan were thought by some to be the breeding places, but the writer has examined many of them and also water in holes close to mangroves and has never found them breeding mosquitoes. Many of the ponds and even some of the ditches contain plant growth. Dr. L. O. Howard states that mosquitoes do not thrive in ponds which contain plant growth, namely algae.

In a bulletin, Fishes and Fisheries of Porto Rico, extracted from the U. S. Fish Commission Bulletin for 1900, *Poecilia vivipara*, a mosquito feeding fish, was reported from Ponce, Fajardo, Arroyo and Hurcares. The material for the above determinations was collected by a detail from U. S. Fisheries Steamer Fish Hawk during 1899 when a survey was made of the fishes and fisheries of the island. The writer found in the streams at Guánica a small fish identified by the Bureau of Fisheries at Washington, D. C. as the same species found in 1899 by the U. S. Fish Commission. Later the same fish has been taken from the streams around Mayagüez. *Poecilia vivipara* and the top minnow belong to the same family, Poeciliidae.

A number of fish have been under observation, being kept in a large tank. They are very fond of mosquito larvae and have been seen eating the egg masses of the common house mosquito of the Tropics. The presence of these fish in streams may account for the scarcity of the malaria bearing mosquitoes and therefore the small amount of malaria on the island.

Breeding places.—Mosquitoes deposit their eggs on the water

(a) Reed. Journ. of Hyg., 1902, II, p. 101.

and when hatched the larvae or wrigglers living in it come to the surface to obtain air. Their food is composed of decayed vegetable matter, microscopic animals and cast off skins of mosquito larvae. Some mosquito larvae are carnivorous and prey upon other species.

The larvae breath through a small tube at the posterior end of the body called a syphon. The pupal state is passed in the water and during this period they breath through two tubes situated on the top of the head. On account of these peculiar breathing tubes, which are thrust through the surface of the water to obtain air, the placing of oil on the surface will destroy them. The oil spreads over the water, making a very thin film, and when the mosquitoes come to the surface to breath their syphons do not penetrate the soil but a thin film forms over the apex of the syphon in the case of larvae and over the breeding tubes of the pupa and the insect suffocates.

Most species of mosquitoes have some special breeding place. *Culex pipens*, the house mosquito of the North, will develop in the foulest water; this is also true of *Culex quinquefasciatus*, the common mosquito of the Tropics. Other forms prefer fresh clear water in which to deposit their eggs. *Anopheles*, the malaria bearing mosquito, prefers clean pools of water to deposit its eggs. They are sometimes found breeding in barrels and tin cans. *Aedes* (*Stegomyia*) *calopus*, the yellow fever mosquito, prefers dark places and may be found depositing eggs in barrels, tin cans and cisterns. Breeding places in general may be divided into two classes; first, receptacles for the storage of water such as cisterns, barrels, etc., and second, standing water such as drains, small ponds and ditches.

Containers for storage of water breed a great majority of the mosquitoes which infest the island: water stored in barrels, tin cans and cisterns for washing and for drinking. During the rainy season the wash women keep their barrels filled with water collected from the roof, but during the dry season they are obliged to carry water from the nearest public water faucet or from springs. Small amounts of water are usually left in barrels so that they will not dry up and leak. Such places make ideal breeding spots and adult mosquitoes come forth every day from such containers. Another breeding place for mosquitoes are tin cans in which washwomen make their potash water lye from charcoal ashes for washing. It seems strange that mosquitoes would lay their eggs in such a mixture and that the larvae would thrive in it, but in every wash yard one or two of these cans can be found and in them mosquito larvae.

The old Spanish cisterns, which were built before the water systems were introduced into the cities, are now breeding mosquitoes. These cisterns are generally found in the patios of the old buildings and sometimes under floors and in hall ways and are supplied with water collected from the roofs. Since water systems have been installed in some of the cities of the island, a few of these cisterns have been filled in and covered. But there are great numbers of them now in use and are covered over with a few loose boards or pieces of tin or burlap. These coverings do not make them mosquito proof but rather excellent places for the mosquitoes to hide during the day and lay during the night. Many of the cisterns are very large and hold thousands of gallons of water; often one cistern collects its water from the roofs of two or more houses, the water being used by a number of families. Cisterns not in use are a worse menace to health as they are sometimes filled up with boxes, bottles and all sorts of refuse. Such places not only breed mosquitoes but flies. Every town or city having a water system should see that the cisterns are sealed or better, filled up.

Tin cans.—A great amount of the food used in this island is brought here in tin cans. What becomes of these tin cans when their contents are used? They are placed on the window sill or in the patio or thrown into the dump; the first rain fills them with water and in a very short time they become the breeding place of mosquitoes. These tin cans are found not only in our cities but also in the country districts.

Cocoanut husks.—Every day thousands of people in our towns and cities drink the milk of the cocoanut. The empty husks are disposed of in the same manner as the tin cans and the same results are had. Each husk catches enough water during the first rain to make a place for the mosquito to deposit its eggs.

During dry seasons tin cans, cocoanut husks and other small water containers dry out and do not breed mosquitoes, but during the rainy season they are constantly being supplied with water and make ideal places for the females to deposit their eggs. Mosquito larvae have been found in broken bottles which have been thrown into vacant lots and patios, also in tins containing water used under the legs of tables and in ice chests set to protect food from ants. Cattle troughs, fire pails and wash tubs with water left standing all make breeding places for the mosquito.

Standing water.—Open drains, cesspools, defective eaves and water, catch basins and ponds, all breed mosquitoes. During the rainy season these places are worse than during the dry season and it is on account of poor drainage that during the wet season we

have more mosquitoes than during the dry weather. Small pools are found along the sides of streets, in patios, in vacant fields, and in any place where there is the least depression. Defective water spouts always drip small amounts of water making pools in which larvae will breed. Cattle troughs breed great numbers of mosquitoes, especially in country sections. During the rainy season standing water is found many times on the tops of the roofs of some of the old Spanish houses. Mosquito larvae have also been found in small depressions in the cement flooring of bath rooms. Fountains breed mosquitoes unless they are cleaned out or the surface of the water treated with oil.

Treatment of breeding places.—To rid a locality of mosquitoes it is necessary to destroy the places in which the larvae develop. It has been said, "that every tenant is responsible for the mosquitoes which inhabit his home."

The adult insect is not a great flyer and the mosquitoes which are found around houses can generally be located not very far away, breeding in some receptacle containing water. There are records, however, of mosquitoes being carried by the wind great distances, but these instances are few. It takes eight and sometimes sixteen days for the mosquito to pass through egg, larval and pupal stages.

This being the case each tenant and property owner can greatly reduce the number of mosquitoes in his vicinity by carefully inspecting his premises one day each week, collecting and destroying all tin cans, coconut husks or any other receptacles that might collect water. All water barrels, cisterns and permanent containers of storage water should be made mosquito proof. Cisterns should be covered with matched lumber set in cement and a pump installed; all vents should be screened with fine wire; water barrels should be screened with wire netting and the water drawn off by a spigot. Earthen jars, cans and ditches used under legs of tables filled with water to prevent ants from crawling upon the table, should be emptied and filled with fresh water every few days, or the surface of the water treated with oil. Dishes of water into which dishes of food are set should be emptied and refilled every few days. Receptacles used for catching water under ice chests should be emptied frequently. Water troughs for cattle, fire buckets and wash tubs should be looked after and the water removed every few days.

Standing water should be drained off or the surface treated with oil; open drains should be treated with oil or if possible done away with and subsoil pipes laid to carry off the water. Defective water spouts or faucets should be repaired and the soil under

them raised so that the water will run off and not form pools. All ponds and catch basins should be treated with oil and in the case of permanent ponds that breed great numbers of mosquitoes, fish should be introduced to destroy the larvae.

PART II.

WORK DONE BY THE EXPERIMENT STATION FOR THE CITY OF SAN JUAN.

At certain times of the year, especially during the rainy season, the mosquitoes in San Juan are very troublesome. The city has never taken up the work nor has it ever studied the problem to any great extent. From time to time there has been some work done by small neighbourhoods but only in a comparatively small scale. A few ponds have been treated with oil, but no mosquito campaign has been taken up since the city was vacated by the army.

During March, 1911, Mr. R. H. Todd, mayor of the city of San Juan, requested the experiment station to send some one to make a mosquito survey of the city to ascertain the possibility of ridding it of mosquitoes and to estimate the cost. The writer was detailed from the station and spent three weeks during the latter part of March and the first part of April, looking over the city of San Juan.

The city is divided into three sections, San Juan, Puerta de Tierra and Santurce. San Juan proper and Puerta de Tierra form an island surrounded by salt water not brackish. Santurce is almost an island. It is surrounded on the northwest and south by salt water, and on the east by a river which connects the harbor of San Juan with the laguna. There is a very narrow strip of land on the northeast which connects Santurce with the main land, otherwise the whole district of San Juan proper, Puerta de Tierra and Santurce would be an island. From the position of San Juan and considering that the prevailing winds are from the ocean, it seems very probable that the mosquitoes found there probably breed within its borders. A few mosquitoes are probably blown from Cataño, but if the city was once cleaned up and inspectors kept the breeding places under control, these few mosquitoes which may come in from outside sources would not cause discomfort as they would not have any breeding places to infect.

After looking over the problem it seemed advisable to obtain the assistance of the city board of health and the insular police. The city board of health detailed one of its health inspectors to

accompany the writer in his personal survey, while the police took up a house to house inspection of the city. The following system was carried out. Cards for recording the various infections were given each inspector and a certain district to work. The cards were the regulation 4x5 in. used in card catalogues. They were printed on both sides and proved to be very satisfactory. Below is a sample.

“Date: April....., 1911. No.....
 District where infection was located
 Name of street..... ..Number of house....
 Sources of infection:
 1 Cisterns
 2 Water barrels
 3 Fountains
 4 Tin cans
 5 Standing water
 6 Old cocoanut shells or husks
 7 Open drains

Remarks:

Notes made by.....”

On the opposite side of the card were instructions for the police, as follow:

“Object of work is to locate where the larvae of the mosquitoes of San Juan are breeding.

Instructions.—Visit every portion of your beat; enter all yards and vacant fields, inspecting all receptacles which contain water. Pay special attention to cisterns, wells, fountains, water barrels, tin cans, shells and husks, bottles filled with water, standing water and open drains. It is in such receptacles that mosquitoes breed.

Directions for collecting larvae of the mosquito.—From each receptacle collect from 15 to 40 larvae and place in small bottle containing alcohol. Do not collect larvae from two or more containers and place in the same bottle; use separate bottles for each.

Use one card for each infection.

The collection number on the bottle shall be the same as the number of the card.

If sufficient specimen bottles are not supplied continue with the work, filling out the cards.

Indicate by crosses the sources of infection. All other

breeding places not indicated on the cards place on the space marked "Remarks:".

The cards at the end of the day are to be turned in to the Chief of Police. These cards are to be used in plotting the city and will later be used to guide the inspectors in their work in exterminating the mosquito breeding places.

It is important that you locate every mosquito breeding place in San Juan.

The finding of mosquito breeding places on any property is not a misdemeanor nor will said occupants be denounced.

It is, for the good of the people of San Juan that this survey is being taken up, and the Mayor, the Board of Health, and the Chief of Police wish the cooperation of the people."

Below is a table showing number of the infections found in San Juan, Puerta de Tierra and Santurce. Of the 739 infection places listed, the police collected from them over 100 samples of larvae and from these was formed the opinion, as to the species of mosquitoes and their breeding places in San Juan.

Table Showing Number of Cards Found
Below per District.

San Juan proper	228 cards	469 infections
Puerta de Tierra	50 "	58 "
Santurce	208 "	212 "
	546 cards	739 infections.

San Juan proper showed the greatest number of infections, second Santurce and lastly Puerta de Tierra..

Below is a table showing the different breeding places located in the San Juan district.

Table Showing Infections.

	San Juan	Santurce	Puerta de Tierra	Total.
No. 1 Cisterns	213	11	4	228
" 2 Water barrels	40	88	30	158
" 3 Fountains	1	3	1	5
" 4 Tin cans	148	18	4	170
" 5 Standing water	49	50	9	108
" 6 Coconut husks	16	15	5	36
" 7 Uncovered ditches	2	23	5	30
" 8 Iron tanks	2	4	5	11
	469	212	58	739
		222	63	285

From the tables of infection San Juan proper shows 469 breeding places or 63 per cent; Santurce, 212 or 29 per cent, and Puerta de Tierra, 58 or 8 per cent.

Both Santurce and Puerta de Tierra showed a much higher percentage of water barrel infections than did San Juan proper; while San Juan had 45 per cent of its total infections in cisterns. The two other mentioned districts had very few.

Tin cans were very plentiful in San Juan proper, 32 per cent of the total for the city, while Santurce had 8 per cent and Puerta de Tierra 7 per cent. Standing water was more prevalent in the districts which were not thickly populated, although the city proper showed a high percentage of these infections. These were mostly found on the Marina in vacant lots. Uncovered ditches were more numerous in the country districts than in the cities; probably most of those recorded were used for carrying off of surface water where agricultural pursuits are being carried on.

Bottles containing alcohol were given to the police so that they could collect larvae. One hundred and three of these bottles were brought in. Below is a table showing districts where larvae were found and the breeding containers where taken.

	Santurce	Puerta de Tierra	Total.
Cisterns	1	3	4
Fountains	1	1	2
Water barrels	43	24	67
Tin cans	7	1	8
Standing water	8	0	8
Cocconut husks	2	0	2
Uncovered ditches	11	1	12
	73	30	103

From the survey made at San Juan the following data was gathered regarding the breeding places of *Aedes* (*Stegomyia*) *calopus* and other species. There were no larvae collected by the police in San Juan proper. Dividing the city into districts the following figures were compiled for Santurce:

Classification of species of Santurce and where taken.

	Aedes (Stegomyia) calopus.		Culex quinquefasciatus.		Unidentified.		Unidentified.		Unidentified.		Unidentified.		Washington.	Culex with a very long tail.	Total.
Cisterns	1		1		1		1		1		1				3
Water barrels	31	16	28	2	5	1	9								92
Fountains	1														1
Tin cans	6	3	4		1		2								16
Standing cans	2	5	3				3								13
Cocoanut husks							1								2
Uncovered ditches	4	9	6				3								22
TOTAL:	45	33	42	2	7	1	18	1	149						

Table for Puerta de Tierra. 1901.
Classification of species and where found.

	Yellow fever mosquito. <i>Aedes (Stegomyia) calopus.</i>	Common house mosquito. <i>Culex quinquefasciatus.</i>	Malaria Mosquito. <i>Anopheles.</i>	Unidentified.	Unidentified.	Unidentified.	Unidentified.	Totals.
Cisterns	2	1	0	12	1	0	0	16
Water barrels	19	9	0	13	1	7	1	50
Fountains	1	0	0	0	0	0	0	1
Tin cans	1	0	0	1	0	0	0	2
Standing water	0	0	0	0	0	0	0	0
Uncovered ditches	0	1	0	0	0	0	0	1
Iron tanks	0	0	0	0	0	0	0	0
Total:	23	11	0	16	2	7	1	60

For these two districts barrels were the greatest source of infection,—sixty-five per cent. The total number was 67: Santurce 43 and Puerta de Tierra 24. The next source of infection was open ditches,—11½ per cent of the total; Santurce 11 and Puerta de Tierra 1. Tin cans and standing water each showed infection of 7.76 per cent, the lower rate of infections for these two containers may be explained by the scarcity of rain during the period when the survey was made.

Cocoanut husks did not prove to be a source of infection at the time the survey was undertaken. There was very little rain and the husks examined did not contain much water and those that did had very few larvae as the rains were not frequent and

Note.—Many of the bottles of larvae brought in by the police contained as high as four different species.

the water had a chance to dry out before the next shower. They are doubtless more of a source of infection during the rainy season.

Both Santurce and Puerta de Tierra are laundry districts of San Juan proper, which accounts for the great number of barrels used. In looking over these two districts it seemed that every house had a barrel and many of them had two and three. It was not uncommon to see the side of a house lined with water barrels, wooden tubs and pails.

In looking over the figures for Santurce and Puerta de Tierra it will be seen that barrels breed all species of mosquitoes found. The yellow fever mosquitoes were taken 45 times in Santurce and 23 in Puerta de Tierra, and of these 68 infections 50 were taken from barrels, or 62½ per cent of barrels found contained larvae of the yellow fever mosquito.

Many of the cisterns in San Juan proper were badly infested and collections made from them. When every one of these cisterns were uncovered great numbers of yellow fever mosquitoes were observed coming out. From the larvae obtained by the police and from the observations made by myself I believe that the water barrels and cisterns are the greatest sources of infection during the dry seasons, also that most of the yellow fever mosquitoes are breeding in these two water storage containers.

The common house mosquito of the Tropics, *Culex quinquefasciatus*, breeds in barrels and in these sixteen infestations were found in Santurce and nine in Puerta de Tierra, —25 in all or about 57 per cent of the total. A species resembling the house mosquito was found in Santurce in great numbers. Eighteen infections were located. Summing up the infections and the mosquitoes of San Juan, barrels and cisterns are the worst sources of infection during the dry season and the common house mosquito and the yellow fever mosquito are the most abundant species.

WHERE MOSQUITOES BREED IN SAN JUAN.

In San Juan proper mosquitoes breed in cisterns, water barrels, wash tubs, tin cans, broken bottles, containers of water under ice chests, tin cans under the legs of tables, all kinds of tins, pots, cocoanut husks, dishes and bottles on dumps. Standing water under house, in yards and vacant fields; drains, and ditch water, standing water in defective water pots, eaves and gutters, catch basins and cesspools, depressions on the tops of houses, ash or lye water made in tin cans, tubs or other containers of wash

women, cattle troughs, water in fire pail, fountains, flower urns in garden and cemetery and flower vases. In fact mosquitoes breed in anything which holds water long enough for them to develop.

The greatest source for the breeding of mosquitoes in the city proper are the old Spanish cisterns, water barrels and tin cans.

In Santurce the conditions are not the same. The drainage is not as good and there was found more standing water. During the last week of the survey it rained nearly every day and many pools developed. These pools were found in vacant lots, under houses, and along the road side.

Back of stop 15 many of the houses were standing in water and thousands of mosquitoes were breeding in the ponds under them. One house, for example, had a pond under it, the concrete walls keeping the water in although it could have been easily drained off as the ground under the house was much higher than that outside. In fact, a small stream flowed by just to one side of the property and the water could have been drawn off with a 2 in. pipe. The filling in or draining of such breeding places as these would make a locality more healthful and the expense would be very small.

CONCLUSIONS

The ridding of San Juan at the time when the survey was made was a question of cleaning up the city. The mosquitoes were breeding in places which could easily be treated. The treatment of the cisterns will be more difficult. They will either have to be filled in, covered with cement or with matched lumber. If their water is to be used a pump should be installed.

Barrels should be screened and the water drawn from them by faucets or they may be dispensed with provided the city will establish more faucets so that the people will not have to depend on storage water. Tin cans and small containers of water can all be removed without any one really suffering or being the least inconvenienced.

Getting rid of the mosquitoes in San Juan is a matter of public sentiment and if the people are interested, and they are the ones to be so, the work can be done and good results can be accomplished. The whole matter in two words is "Clean up" and by way of emphasis "Clean up and this means you".

I believe that if the people of any town or district on this island thoroughly understood how mosquitoes affect health there would be a great army of helpers and a clean island. The information regarding breeding places and treatment of them should be

published and posted in conspicuous places. Then with a good force of inspectors to explain, to instruct, and to enforce ordinances we would have a mosquito-free country.

RECOMMENDATIONS TO THE CITY OF SAN JUAN.

Honorable R. H. Todd.

San Juan, P. R.

Sir:—

I beg, herewith, to submit the following recommendations on mosquito control to the Honorable Board of Aldermen of the city of San Juan.

1. That the following ordinances be passed:

- A. That all cisterns be sealed with cement or made mosquito proof with matched lumber; all vents screened and made mosquito proof. If water is to be obtained from cisterns it shall be raised by a pump inserted into a mosquito proof cover, and the installation shall be inspected by the Board of Health.
- B. All water barrels shall be screened and water drawn off by spigots.
- C. The storage of water in any receptacle, such as tin cans, half barrels, old boilers, tanks, dishes, water jars, etc., be prohibited.
- D. All water in fountains shall be treated with oil or with mosquito feeding fish.
- E. All water collected under ice chests shall be emptied once every two or three days.
- F. Tin cans filled with water and placed under the legs of tables, or dishes of water in which other dishes of milk, water or other food is set, shall be changed every two or three days.
- G. Drinking troughs for horses or cattle shall be emptied and swept clean every two or three days.
- H. All standing water shall be removed by ditches or surface treated with oil.
- I. The above ordinances shall be accompanied by a fine.

2. For the enforcement of the above ordinances I recommend that there be appointed six inspectors who shall have authority to enter all property. First: They shall rid the city of all breeding places, with the assistance of a force of men. Second: When the city is cleaned the inspectors shall patrol their districts, every

four or five days and enforce ordinances on mosquito control. Inspectors shall report to the Board of Health any infections found in places not mentioned in the ordinances. Inspectors shall be instructed to oil all catch basins during the dry season every ten days if mosquitoes are found breeding in them.

3. I recommend the following plan for cleaning the city. That the city be divided into six districts as follows:

District	1.	Part of city south of San Francisco St.
"	2.	Part of city north of San Francisco St.
"	3.	Part of city west of Stop 6 (Puerta de Tierra)
"	4.	Part of city east of stop 6 (Puerta de Tierra)
"	5.	Part of city north of trolley line (Santurce)
"	6.	Part of city south of Trolley line (Santurce)

Collect all tin cans, cocoanut husks, water jars, empty bottles, crockery and other containers of water, not mosquito proof and carry to dumping ground where they shall be destroyed and not left to breed mosquitoes. Open all ditches; drain all small ponds and remove by drains any other standing water. If imposible to drain treat surface with oil every ten days.

4. I recommend that a card or poster 12x18 in. be printed with information concerning the mosquito breeding places and the treatment of same; also that if the ordinances are passed they be printed on the poster and that the posters be placed in conspicuous places in the city.

MOSQUITO NOTES.

Contents of cards. Every tenant raises his own mosquitoes. We do not expect to kill every mosquito in San Juan, but we wish to get rid of all standing water and all containers which breed them. We expect that we will have invasions of mosquitoes from other localities, being blown into the city by the winds, but when these invasions occur we hope to have eliminated the breeding places so that these foreign born mosquitoes will find no place to establish themselves. One mosquito will deposit from 200 to 400 eggs in a cluster. Mosquitoes carry malaria and yellow fever.

Mosquitoes breed in cisterns, barrels, fountains, tin cans, cocoanut husks, ditches, bottles, depressions on roofs, tanks in vacant houses, catch basins, water pails under wash basins, tins under ice chests, old crockery, drinking troughs, cans in which lye is made for washing purposes or in any other place where water is permitted to stand.

For instructions concerning the destruction of larvae in the above containers read the previously mentioned ordinances.

5. I recommend that an appropriation of \$5,000 be made to carry on this work. Also the city proper and Puerta de Tierra be cleaned first; also, work to commence as soon as the cards are printed and posted.

Respectfully submitted,

(Signed) W. V. Tower,
Entomologist.

MOSQUITO WORK TAKEN UP AFTER THE SURVEY OF 1911

After the above recommendations were presented to the Mayor recommending a general clean up with a detail of men to actually rid the city of its mosquito breeding places, it was found that there were no funds which could be used for the projected campaign.

On July 1st, 1911, the Insular Government took over the sanitary work of the island and all such comes under the Sanitary Board.

Since the March 1911 mosquito survey was made in San Juan the community known as the Park, a residential section of San Juan, has been very active in mosquito work. The neighbourhood has formed a league called "The Borinquen Anti-mosquito League". They have given stereopticon lectures on the life-history and breeding places of the various species of mosquitoes and have taken up other educational work. In the small stores in the neighbourhood they have placed on the counters breeding glass jars containing larvae. These jars are being watched by the people who are learning about the habits, breeding places and the development of the mosquito. The main object of the League is to get the people interested so that they will destroy the mosquito breeding places.

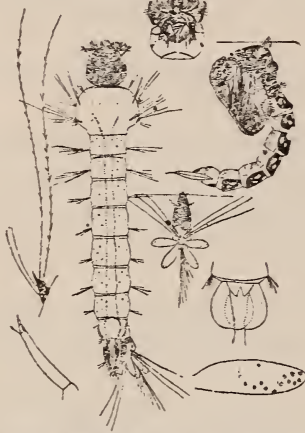
Below is the reading matter taken from the printed poster issued by the Borinquen Anti-mosquito League.

PLEASE TACK THIS POSTER IN A CONSPICUOUS PLACE.

MOSQUITOES.

Campaign of the Borinquen Anti-mosquito League.

MOTTO: "NO STANDING WATER."



Larva and pupa of the yellow-fever mosquito, greatly enlarged. Note breathing organ of larva, shown in center.
(From Dr. L. O. Howard, U. S. Bureau of Entomology).



Adult of yellow-fever mosquito, greatly enlarged.
(From Dr. L. O. Howard, U. S. Bureau of Entomology).

To a great extent we breed our own mosquitoes and if we free our own houses and dooryards of breeding places, we will always obtain partial relief and we will many times secure entire relief. Read carefully these mosquito facts and the rules for their destruction.

MOSQUITO FACTS:

Mosquitoes convey malaria, yellow-fever, and elephantiasis from infected people to healthy persons.

Mosquitoes depreciate the value of property, prevent the investment of capital, and drive away homeseekers and visitors. Mosquitoes breed *only* in water. Their breeding places are usually artificial collections of water. If we destroy these breeding places, we destroy the mosquitoes.

The young mosquito larvae or "wigglers" live in water from 10 to 12 days before emerging to the air as adult winged mosquitoes.

Mosquitoes usually occur in the vicinity in which they breed.

Mosquitoes require only a small amount of water in which to breed. A large number will breed in a few ounces of water in an old tin, a broken bottle, or a discarded coconut shell; hundreds will breed in a partly filled rain-water barrel; and thousands will breed in a cess-pool.

Although the young mosquitoes or "wigglers" live in water, they must breathe air and they come frequently to the surface of the water to obtain air. Coal oil on the surface of the water will prevent the wriggler from breathing and they will be destroyed. The oil does not affect the water for use if the water is drawn off from below. 1 ounce of coal-oil is sufficient to cover 15 square feet of surface.

CAMPAIGN RULES:

Clean up your dooryard and the adjoining vacant lots of all discarded coconut shells and husks, cans, tins, bottles, and broken crockery and bury the rubbish or have it carted away.

Discontinue the use of all unnecessary tubs, barrels, buckets, and cans about the place as containers of standing water.

Empty, clean and refill, at least once a week, all necessary containers of standing water in use about the house, stable, chicken coops, etc.

Fill in or drain all pools, clogged ditches, excavations, etc., about the place, where water is standing.

See that the plumbing about the place is in perfect order, prevent leakage of pipes and clogging of eaves and drains.

Clean away all grass and weeds from about ditches and low places, since the vegetation affords a hiding place for adult mosquitoes and, further, these locations will then dry out or drain off more readily.

See that the cess-pool cover is absolutely tight. Flush a pint of coal-oil down through the closet to the cess-pool at least once a week. Treat all open closets in which there is standing water with coal-oil regularly.

Put wire-netting over all cisterns and tanks of water.

Treat with coal-oil all locations of standing water which cannot be filled in, drained or screened.

Inspect all neighborhood collections of water and sink-holes. Search carefully for "wigglers" in the wayside surface-sewers, and under culverts.

Relief from mosquitoes depends entirely upon the co-operation and the concerted action of all the members of this community.

The poster is neatly gotten up and at the top of the card is a print showing the life history of the mosquito.

Commencing August 1911 the "Borinquen Anti-mosquito League" has an inspector whose duty is to visit each house, inspect the grounds and instruct the people regarding where mosquitoes breed and the diseases which are carried by them.

The Sanitary Board is furnishing the inspectors for this work, also the carts for clean-up days. The work being done by this community is excellent and it will be only a short time when the people will see results. Such work always gives relief but it must be remembered that if it is not kept up it will not be long before new breeding places develop and the community becomes as bad as it was before the campaign.

At some of the large sugar centrals the people are taking an interest in the mosquito problem. At Centra Aguirre they are using mosquito oil treating the water barrels, cisterns, cesspools, and any standing water in the immediate vicinity.

During August 1911 an officer of the United States Army was detailed from the Canal Zone to study the mosquito problem of the island under the Sanitary Board. This is excellent work which the Board is undertaking, but to accomplish the best results in the shortest possible time it needs the cooperation of all the people of the island.

Although the city of San Juan could not carry out the recommendations which were presented to them, the data which was gathered at that time has been very useful. It has been used by the Borinquen Anti-mosquito League and by the Insular Sanitary Board as a base to work upon.

